

241: Chemical Catalysis

Chemical Systems

(01.0203)

1- [REDACTED]

7-W

STATINTL

U.S. - U.S.S.R. Exchange Program
in
Chemical Catalysis
at
Institute of Chemical Physics
(Moscow)
from
September 15, 1975 - December 15, 1975
by

James A. Dumesic

FILE 01.02 - Chemical Catalysis

the following is a short report regarding the scientific part of my three month stay at the Institute of Chemical Physics, in Moscow, U.S.S.R. For convenience, the contents of this report are organized into three sections: (i) Research Conditions and Results, (ii) Scientific Visits and Discussions, and (iii) Recommendations.

Research Conditions and Results

At the Institute of Chemical Physics, I worked in the Moscow laboratory of Professor Goldanskii; at this laboratory, my general research area was the study of catalytic phenomena using Mössbauer spectroscopy. For this reason, problems in instrumentation should be considered, and it will be seen that problems of this type were indeed important during my three months in Moscow.

Mössbauer spectroscopy begins with a radioactive nuclide in a "source" which emits a γ -ray, and during the emission the γ -ray energy is modulated by imparting a well-known velocity to the source (taking advantage of the Doppler effect). Our first problem in Moscow was that the radioactive sources available were very weak, i.e. of the order of 1 mc. For the catalyst systems that were of interest to us, this meant that the data collection times were ca. 24 h; however, we were not allowed to record Mössbauer spectra overnight (because the electricity was turned off during the night). Thus, the research pace was unfortunately slowed by these factors. In addition, it was difficult to operate an effective vacuum system when one considers the long start-up and shut-down times in the morning and evening respectively due to the overnight power shut-down in the laboratory.

With respect to γ -ray energy modulation using the Doppler effect, the unit which produced the well-known source velocity also produced some problems for us. This velocity drive was hand-made in the laboratory, and as can be expected, we found non-linear effects in the motion at low velocities; this produced asymmetric peaks in the Mössbauer spectra near zero velocity. Each time we changed the velocity range to be scanned (e.g., $\pm 10 \text{ mm s}^{-1}$ to $\pm 3 \text{ mm s}^{-1}$), we first spent considerable time adjusting the velocity drive to minimize the non-linear effects.

The preceding two factors certainly made data collection difficult; but, data collection was possible. On the other hand, some of the equipment in the laboratory was broken beyond repair. For example, the system for studying the γ - γ coincidence effects in Mössbauer emission experiments was not in working condition during my three months in Moscow. If I would have come to Moscow with the intention of working on that system, I would perhaps have been surprised considering the state of communication between our two countries.

It is interesting to note here that Professor Goldanskii also has a Mössbauer laboratory outside of Moscow (about 40 km) in Chernogalofka. After speaking with my Russian co-workers in the Moscow laboratory, I was given the impression that the equipment in the Chernogalofka laboratory is superior to that in the Moscow Mössbauer spectroscopy laboratory. Unfortunately, Chernogalofka is off-limits to the American exchange fellows, apparently for security reasons. In addition, it should be mentioned that the

new research direction for Professor Goldanskii's laboratories is the study of biological problems. Starting in 1976, about 80% of his group will already have been shifted to this field. Thus, one working in catalysis tends to feel a bit "isolated" in Goldanskii's group.

My research efforts in Moscow were directed essentially in the two following areas: (i) the study of the promoting effect of SnR_4 (where R = butyl) on Re_2O_7 catalysts for olefin disproportionation reactions, and (ii) the preparation of a paper dealing with Mössbauer spectroscopy studies of the state of catalysts during catalysis. In the first case, it was known that Re_2O_7 supported on $\gamma\text{-Al}_2\text{O}_3$ is a catalyst for olefin disproportionation reactions at room temperature; however, the addition of SnR_4 to the catalyst can increase the activity by two orders of magnitude. In addition, the catalytic activity does not vary linearly with the amount of SnR_4 on the catalyst, and there is an optimum amount for a given $\text{Re}_2\text{O}_7/\gamma\text{-Al}_2\text{O}_3$ sample. Since ^{119}Sn is an excellent Mössbauer isotope, this system was well suited for study by us. We collected Mössbauer spectra for a series of catalysts with different amounts of added SnR_4 . We observed a correlation between the form of the Mössbauer spectrum and the catalytic activity. Specifically, when the amount of added SnR_4 was less than the optimum value, two peaks were seen in the Mössbauer spectrum, corresponding probably to O_2SnR_2 (SnR_2 bound to two surface oxygen ions). This species is responsible for the promoting effect of the tin-organic. When the amount of added SnR_4 was greater than the optimum value, three

peaks were seen in the Mössbauer spectrum, corresponding to both O_2SnR_2 and another species on catalyst surface. This second species (perhaps SnR_4 itself) then blocks the O_2SnR_2 catalytic sites and thereby decreases the overall activity of the composite catalyst system. These preliminary results and others dealing with the Re_2O_7/Al_2O_3 system will be published in the International Journal of Catalysis (edited by Boreskov).

In the second direction of work mentioned above, I prepared a text (with Yu. Maksimov) which discusses the use of Mössbauer spectroscopy in studies of catalysts during catalysis. We dealt with the experimental considerations in studies of this kind, and we discussed examples from our two laboratories (Stanford University and the Institute of Chemical Physics) of Mössbauer spectroscopy studies of metallic and oxide catalysis during catalysis. I presented this paper at the Mössbauer Methodology Symposium in New York on February 1, 1976; the text will be published in Mössbauer Effect Methodology 10, 1976.

Scientific Visits and Discussions

In an exchange program of this type, scientific visits and discussions are important (especially when one considers the experimental and equipment problems that must be overcome to accomplish any research in a short period of time, e.g. 3 months).

On July 15, 1975, my NATO fellowship in France terminated; however, the Soviets delayed my entrance visa into their country until September 15, 1975.

During this two month period, I was supported by the U.S.-U.S.S.R. exchange program, and I went to Denmark to finish writing a review (with Henrik Topsøe) of Mössbauer spectroscopy applications to heterogeneous catalysis. I would like to mention here that I am grateful to the Haldor Topsøe Research Laboratories for their open hospitality during this period.

On August 25th, I went for one week to Crakow, Poland where I attended the International Conference on Mössbauer Spectroscopy. There I was co-chairman (with Henrik Topsøe) of the catalysis section of this conference.

My stay in the Soviet Union began on September 15, 1975 and my first visit outside of my laboratory was to the Institute of Catalysis in Novosibirsk (October 20 - 25). I spent the 5 days at this institute in the laboratories of (i) adsorption, (ii) metallic catalysts, and (iii) oxidation catalysts; in addition, I found the people quite open scientifically, and my visit was truly enjoyable and rewarding.

The second scientific interaction with personnel outside of the institute came on November 14, 1975; this was the start of the first joint scientific seminar between the Soviet Union and West Germany, and the subject was Mössbauer spectroscopy. Germany sent a delegation of 10 men including several of the top men in the field, i.e., U. Gonser, M. Kalvius, H. Wegener and R. Mössbauer himself. The seminar lasted for 10 days during which many exciting presentations were made; one day was devoted to catalysis, at which time I presented a 1 hour lecture. In addition, the Germans and I visited several other laboratories in Moscow that are involved in Mössbauer spectroscopy, i.e., the Kurchatov Institute of Atomic Energy (Afanasyev and Kagan

In early December, 1975, I visited for one day the laboratories of Krylov in the Institute of Chemical Physics (Moscow); shortly thereafter, I spent one day at the Institute of Organic Chemistry. Then on December 15th, my stay in the Soviet Union ended, and I returned to Madison, Wisconsin.

The scientific communications and discussions that I had within my assigned laboratory must now be mentioned. I worked almost exclusively with Yu. Maksimov, who is a very competent chemist and Mössbauer spectroscopist; I consider my interaction with him as the single most important benefit of my three months in Russia. I also had a number of discussions with Yu. Krupyanskii, who was my official guide in Moscow. As mentioned earlier, however, most of Goldanskii's laboratory is studying biological problems, and scientific discussions with the other workers in the laboratory were minimal. In addition, I. Suzdalev (who also studies catalytic phenomena using Mössbauer spectroscopy in Goldanskii's laboratory) was in West Germany during my stay in Moscow, and I saw him for only one week when he returned to Moscow for the West German-Russian joint seminar. Finally, Professor Goldanskii is a very busy man, and I talked with him only twice during my entire stay in Russia, i.e., once during my first week in Moscow when Professor M. Boudart visited the Institute, and once on my last day in Moscow before I left for the airport.

Recommendations

Most of my recommendations for improving (or even continuing) the

exchange program. ~~Approved For Release 2001/09/03 : CIA-RDP79-00798A000300040013-7~~ Before someone is sent to a given laboratory, a list of the equipment (in working condition) that is available to the exchangee should be obtained. Please note, that the available and working equipment in the laboratory may not include all of the equipment in the laboratory. Also, the exchangee should know what chemicals and gases he will have at his disposal immediately upon his arrival in Russia. Ordering chemicals in the Soviet Union can be a long and painful process. This point brings up a more general recommendation: the Soviets should be ready for the visit in their laboratory. If work is to be done in a short period of time, then a fast start is advantageous. Thus, communication between the exchanging laboratories is highly advised before the actual exchange takes place. This can perhaps be best accomplished by sending the American sponser (Professor M. Boudart in my case) to visit his Soviet counterpart and the respective Russian laboratory before the American exchangee is sent to the Soviet Union. Finally, visits to several Soviet Institutes and cities is an integral part of the exchange program; these visits should be arranged and agreed upon before the exchange takes place. In my case, a visit "under consideration" when I began my visit turned out to be a visit "cancelled."

In everything, one may find good and bad points. With respect to my visit to the Soviet Union, I have tried to include both the good and bad aspects. For a true evaluation of the exchange program, however, I suggest that you bring together all of the American exchangees and their sponsors for a panel discussion of the subject.

Part II

Living in Moscow

Part II of this report is a general discussion of the living conditions and experiences while living in the Soviet Union. Prior to departing for Moscow, I was supplied with a report of a previous exchange couple, Dr. and Mrs. Wiel, who were in Moscow in the Spring of 1974. The Wiel's report was most complete and gave an accurate description necessary for meeting ones daily needs in Moscow. Instead of repeating that information, I will simply supplement their report with some additional comments.

Whether staying at the Academy of Sciences Hotel or one of their apartments located at 7 Gubkina, one of the first concerns is locating restaurants and/or food shopping facilities. When going to a restaurant, it is advisable to make a reservation in advance and carry a letter confirming this reservation to present to the doorman. Both can be obtained through the Intourist at the hotel or at the American Embassy. For convenience if staying at the Hotel, there is a cafe on the ground level and buffets on the 7th and 11th floors for small meals. Nearby, in the Warsaw Hotel, is a restaurant on the 14th floor (a reservation is necessary).

Below is a list of other restaurants worth trying when in Moscow:

Aragvi - 6, Gorky Street; tel. 229-73-24; Georgian cooking.
Ararat - 4, Neglinaya Ulitsa; tel. 295-92-12; Armenian cooking.
Baku - 24, Gorky Street; tel. 299-80-94; Azerbaidjani cooking.
Berlin - 3, Ulitsa Zhdanova; tel. 288-25-88.
Hotel Metropole, 1, Prospekt Marxa; tel. 228-40-60.
Praga - 2, Arbat Square; tel. 228-92-75; expensive.
Hotel Rossiya - Near Red Square, across from St. Basil's.
tel. 298-91-87

Hotel Varshava (Warsaw Hotel) - 2/1, Oktyabrskaya Ploshchad;
tel. 233-00-32 ext. 1-30

Kazbek Cafe - a block from the Mayakovsky Theater on
Gertsen Street; cafe; Georgian cooking.

Shopping:

A. Food

1. Near hotel - various bakery, produce and bakery shops on
Leninsky Prospekt; 2 or 3 blocks from hotel.
2. 17, Gorky Street - Armenian goods.
3. 27/24, Gorky Street - Georgian goods.
4. New Rynok (a market near apartment) - Lomonovsky Prospekt
and Vavilova Ulitsa; Note: try to shop at this farm market
early in the day when the produce is fresh and in larger variety;
often can bargain price.
5. American Embassy Commissary - limit of purchases not
exceeding \$100 per single student or \$200 if married. Must
be registered with P&C prior to shopping. No frozen food
privileges. Contains mostly dry and can goods, all staples,
and many toiletries.
6. Hard Currency Shops (Dollars or Travelers Cheques)
 - a. Gastronom - Bolshaya Dorogomlevskaya (the street behind
Kutuzovsky Prospekt); fresh fruits and vegetables, meats
and poultry, dairy products, canned goods, American and
European cigarettes, liquors and some bakery products.
 - b. Diplomatic Gastronome (D-coupons only -- available only
if children are accompanying through the American Embassy) -
Dorogomilovskaya Bol'shaya.

B. Department Stores

1. GUM - on Red Square
2. TSUM - Petrovka behind Bolshoi Theater

3. MOSKVA - 56, Leninsky Prospekt, 1 block from apartment.

C. Souvenirs

1. Beriozkas (Dollar Shops)

- a. 25a, Luzhnetsky Proyezd (across from the Novadevechy Monastery).
- b. 7, Kutrezousky Prospekt
- c. Hotels - RossIay and Ukraine have the largest stores.

2. Rouble Shops

- a. 1/5 Kutuzousky Prospekt
- b. Exhibition Center - (around corner from above #a on dead-end street).
- c. Across street from Intourist Hotel
- d. Exhibition - Dimitrova (across street from Warsaw Hotel).

General Comments

Mail

Explained in detail in the Weil's report. Do not hesitate to give the Vienna or Helsinki addresses out prior to your departure; if not, mail will be painfully slow the first month.

School Facilities

There is an Anglo-American School in Moscow run by the American, English, Australian and Canadian governments jointly. If you have children, it would be advisable to contact the school prior to arriving in Moscow via the American Embassy there or by writing directly to:

Anglo-American School
c/o American Embassy
APO
New York 09862

The school has Kindergarten through 8th grades; and at this time the tuition is

\$750 a semester and \$1500 per year. The main building is located at 26,

Approved For Release 2001/09/03 : CIA-RDP79-00798A000300040013-7

Kropotkinskaya Pereulok. My wife worked as a volunteer at the school during the day and found it a very rewarding and satisfying experience.

American Embassy

It would be advisable to contact the American Embassy in person shortly after arriving in Moscow both with the P&C and the Scientific Departments. Both will provide various information that will assist you during your stay in Moscow. You can obtain an English map of Moscow at the Administration Office (the Russian maps seem to be somewhat inaccurate). Laundry facilities and services are available at the Embassy using American washers and dryers.

Giardiasis

There have been a few people in the Soviet Union which have been infected with the intestinal parasite *Giardia lamblia*. It is probably contracted by consuming tap water, or ice or drinks made from tap water. The best way to avoid the infection is by boiling the water before use. It can be avoided also by treating chemically the water with iodine in the form of globaline tablets or tincture of iodine (1 tablet or 3 drops respectively per quart of water). Although not many cases were reported in Moscow, one of our friends contracted the disease in Leningrad as he was unaware of the parasite. More information is available at the American Embassy.

Miscellaneous - Items to Bring to Moscow

1. Extra passport photographs (about one dozen)
2. Masking tape - particularly if staying through fall and winter in order to seal windows from the winds.

3. Heavy-duty string.

4. Washable clothes, do not bring dry clean items. You will find that garments get quite dirty in a short period of time so darker clothes are preferred.

5. Large bath towels.

6. Books, particularly showing American pictures. This is a nice item to give as a gift to Russian friends.